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Austrian Economics and Game Theory: a Preliminary Methodological Stocktaking

by
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Abstract
This paper discusses, from the perspective of Austrian economics, the merits and drawbacks of game theory in economics. It begins by arguing that Austrians have neglected game theory at their peril, and then argues that game theoretic reasoning may be one way of modelling key Austrian insights, although some aspects of game theory doesn't square easily with Austrian economics. However, a major stumbling block for an Austrian acceptance of game theory may lie in the traditional Austrian resistance to formal methods.

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I. Introduction

This paper is founded on the following conviction: In order for the Austrian critique of mainstream economics to have any bite and relevance, Austrians should relate, not so much to what is in the textbooks, but to what is happening on the frontiers of mainstream economics (in other words, what will be in the future textbooks). Obvious as this may sound, I nevertheless believe that Austrians have been particularly bad at relating to one very important trend in the development of mainstream economics during the last two decades: the rise of game theory. This is serious problem for several reasons, most notably because game theory simply is so crucially important in the contemporary mainstream. Though admittedly simplistic, there is much to say in favor of the view that general equilibrium theory died and game theory to a very large extent took over as the foundational approach of modern mainstream economics (Rizvi 1994). However, Austrians continue to be strongly critical of general equilibrium theory (e.g., Kirzner 1997; Boettke 1996), but neglect game theory at their peril.

As Franklin Fisher (1989: 113) noted, in the nineteen-eighties, "... game theory came to the ascendant as the premier fashionable tool of microtheorists", and it has certainly not lost that position, as inspection of virtually any mainstream journal will confirm. Thus, what may be the major mainstream theoretical advances in the 1980s and 1990s, such as the theory of contracts and the theory of auctions, have been almost completely driven by game theory methods. Moreover, game theory has invaded political science (e.g., Calvert 1995) and biology. This amazing development is in itself an important reason why Austrians should take a stand on game theory.

A further reason to take an interest in game theory is that it has been argued to address exactly the dynamics of the market process that Austrians have so vigorously criticized the mainstream for neglecting.[1] Indeed, the argument may be put forward that the Austrian dynamic conception of the market process as one of entrepreneurial discovery has been made redundant by advances in applied game theory, particularly in the context of industrial organization. As I shall argue, this is hardly the case, however, but it does suggest that, from an Austrian point of view, the new game theoretical industrial organization (IO) (e.g., Krouse 1990) may be seen as an advance *relative* to the old-fashioned structure-conduct-

[1] See Vickers (1995) for exactly this argument (complete with references to Hayek and Kirzner).

performance IO which has for a long time and for good reasons been strongly criticized by Austrians (e.g., Armentano 1982). In turn, this suggests that from an Austrian point of view, there may be both cons and pros of game theory (and its applications in economics).[2] Analyzing these is what I shall be taken up with in the present paper.

Because there are both pros and cons, Austrians need to make up their mind. At least this is what the present paper shall attempt to do. My conclusion essentially is that Austrians ought, not to embrace, but at least to approach game theory. Granted, there is much that is objectionable in game theory from an Austrian point of view. Austrian subjectivism would seem to rule out, for example, the common knowledge assumption,[3] the idea of consistently aligned beliefs,[4] and the idea of the quantifiability of individual utilities, as reflected in supposedly objective pay-offs. Indeed, sometimes game theory represents excesses that not even proponents of the more extreme versions of general equilibrium theory would engage in, such as the basic idea in much of game theory that agents, even in very complex settings, can coordinate on any desired equilibrium.[5] And most emphatically, the notion of the market as one of rivalrous entrepreneurial discovery in the Kirznerian (Kirzner 1973, 1997) is not present in game theory (in spite of the effort of Littlechild 1979), although I shall argue that it is possible to treat it.

On the whole it is fair to say that the frontiers of contemporary game theory is actually *to some extent* taken up with issues that have been central in Austrian economics for a very long time, such as subjective perceptions of other players and of the game (e.g., Littlechild

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[2] There are certainly many general problems with game theory, such as the uncertainty surrounding the so-called "Nash project" (that all cooperative games can be reduced to non-cooperative games by modelling pre-play communication in non-cooperative terms) (see also Tullock 1992 for some interesting reservations). In this paper, however, I concentrate on those aspects of game theory that are particularly problematic to Austrians.

[3] "Common knowledge" is an approach to expectations formation that may be represented by the following sentence: "Jack knows that Jill knows that Jack knows .... that X" − an infinite sentence. For a discussion of some of the problems of common knowledge, see Bicchieri (1993). One problem with common knowledge is that small deviations from it can completely change outcomes (Rubinstein 1989).

[4] "The idea of consistently aligned beliefs" is closely related to a number of related ideas, such as the so-called common priors assumptions. It essentially means that rational people who have access to completely identical information cannot develop different thought processes with respect to the issues that the information concern – an idea that doesn't seem to square easily with the Austrian emphasis on the active and creative mind (e.g., Lachmann 1986).

[5] For example, this is characteristic of much of the game theoretic literature on the theory of the firm (see Foss 1998).

1979; Rubinstein 1991), learning processes (Crawford and Haller 1990), and the role of "rules of conduct" (Hayek 1973) in stabilizing beliefs and expectations. This may not constitute sufficient grounds for Austrians to embrace game theory. But Austrians should recognize that game theory and its application to economics ought to be judged against what came before it, namely general equilibrium theory. From such a perspective, game theory may be seen as a distinct advance – also to Austrians. Something like this was clearly articulated by Austrian fellow-traveller, James Buchanan (1997: 71) when he recently observed that

> [a] major change in economic theory may have occurred in mid-century when the theory of games provided an alternative mathematics to the marginalist calculus – a mathematics that carries important implications for the very way that economists conceive what their enterprise is all about (Von Neumann and Morgenstern 1944). In the theory of games, attention is immediately focused on the interaction process as such ... During the second third of the century, the ongoing dominance of the maximization paradigm tended to obscure the potential contribution that game theory's elegance can make towards restoring ... the catallactic focus of economic theory.

II. Game Theory: Some Background

To a large extent, game theory is an import from mathematics.[6] The two key persons in the early development of the theory, John von Neumann and John Nash, were both trained mathematicians; many (and perhaps most) of the important papers have been (and continues to be) published in mathematics (and statistics journals). As recent research has documented, there was a source of disagreement and confusion in the very different backgrounds and contextual features of the authors of *Theory of Games and Economic Behavior* (1944). Von Neumann's background was in the foundations of mathematics and his involvement in economics had related to existence proofs of competitive equilibrium and

[6] In contrast to mainstream economics (and assuming that the Mirowski story is valid (Mirowski 1989), game theory apparently have few, if any, obvious physics connotations. Actually, both Morgenstern and Von Neumann scorned the fascination with physics that many leading economists have entertained. Not surprisingly, Paul Samuelson has been very critical of game theory (cf. Mirowski 1992: 116n).

growth theory, as well as a general wish to help reforming social science (not just economics) through the supposedly more "scientific" use of thoroughgoing formalization. Though substantively important, his contributions to economics had been few.

Von Neumann's co-author, Oskar Morgenstern, was an Austrian economist, of the same generation as Hayek and Machlup, but (together with Leo Schönfeld-Illy and Paul Rosenstein-Rodan) belonging more to the circle of Hans Meyer than to the Mises Kreis. Morgenstern had taken over from Hayek as the director the Vienna Institute for Business Cycle Research, a position he kept until the Anschluss in 1938, where he – while staying at Princeton University – lost that position. However, in Princeton Morgenstern met Von Neumann and quickly embarked upon the project that became *The Theory of Games and Economic Behavior*.

Morgenstern's primary role in the project appears to have been that of the asker of provocative questions and supplier of ideas on plans, plan compatibility and the role of time in economic affairs – subjects that he had treated in a number of earlier publications (Morgenstern 1928, 1935a&b) that clearly were inspired by Hans Meyer (e.g., Meyer 1932) in their concern with individual plans but also were clearly related to Hayek's interest in the interaction and compatibility of plans. It is not difficult to see the link between mixed strategies in two-person, zero-sum games, and the famous Holmes-Moriarty parable from Morgenstern (1935a: 173-4):

> Sherlock Holmes, pursued by his opponent, Moriarty, leaves London for Dover. The train stops at a station on the way, and he alights there rather than traveling on to Dover. He has seen Moriarty at the railway station, recognizes that he is very clever and expects that Moriarty will take a faster special train in order to catch him in Dover. Holmes' anticipation turns out to be correct. But what if Moriarty had been still more clever and had foreseen his actions accordingly? Then, obviously, he would have traveled to the intermediate station. Holmes, again, would have had to calculate that and he himself would have decided to go on to Dover. Whereupon, Moriarty would again have "reacted" differently. Because of so much thinking they might not have been able to act at all or the

> intellectually weaker of the two would have surrendered in the Victoria Station, since the whole flight would have become unnecessary.[7]

Moreover, Morgenstern's story anticipates quite modern discussions of the paradoxes of common knowledge (see Bicchieri 1992) and, more generally, the role of agents' beliefs in game theory. The Morgenstern parable would seem to indicate the impossibility of perfect foresight equilibria, or at least of perfect foresight processes leading to such equilibria in situations of conflict (O'Driscoll and Rizzo 1985). It therefore indicated, as Morgenstern (1935a) pointed out, the necessity of inquiring into the disequilibrium market process, characterized by the less than perfect foresight of agents, of different beliefs, etc. However, in actuality, very little of this survived in Von Neumann and Morgenstern (1944), where, quite in contrast to Morgenstern's emphasis on the role of different beliefs and imperfect foresight in the market process, most of the reasoning took place with reference to static situations characterized by homogenous beliefs and perfect foresight (Mirowski 1992).

Historically, game theory was initially greeted with considerable enthusiasm in the economics profession (Rizvi 1994; Hargreaves Heap and Varoufakis 1995; Leonard 1995) – an enthusiasm that, however, quickly faded away as application turned out to be harder to accomplish than initially envisaged. Much of the reason was that most game theory discussions and applications were limited to the zero-sum, two-person games that Von Neumann and Morgenstern had been primarily taken up with. But another reason, which is perhaps more interesting in the present context, is that Von Neumann and Morgenstern's book was actually interpreted as a major attack on the emerging Hicks-Samuelson orthodoxy (Leonard 1995: 731).[8] Since this orthodoxy was interpreted as an attempt to basically found the core areas of economic analysis on the competitive equilibrium model, the game theory concern with small-scale interaction was interpreted as a provocative new agenda, and to some extent suppressed as a dangerous heresy that introduced unnecessary complications.

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[7] Actually, it is conceivable that it was Morgenstern's concern with such infinite regress situations that led to the idea of a mixed (probabilistic) strategy (Holmes and Moriarty should flip the coin and choose a strategy). In a related context, Tullock (1992: 28) argues that the feeling that because of the infinite regress there is actually no true solution is "... a correct description of the game ... Von Neumann and Morgenstern (1944) purported to get out of this problem by producing a mixed strategy for such games".

[8] This may also have something to do with the fact that Morgenstern earlier (1941) had penned a vitriolic attack on Hicks' *Value and Capital*.

Given this, it is ironic that one the first applications of game theory in economics to make a serious impact is Debreu and Scarf (1963). Not only was this paper published 19 years after the publication of von Neumann and Morgenstern (1944), but it also utilizes game theory in the context of what should be seen as an attempt to further the general equilibrium program.[9] Somewhat earlier, Arrow and Debreu (1954) had made reference to Nash (1950),[10] but only because they were inspired by Nash's use of the Kakutani fixed point theorem to prove existence of equilibrium in n-person games. Moreover, Martin Shubik had published his application of game theory to IO, *Strategy and Market Structure: Competition, Oligopoly, and the Theory of Games* in 1959. But it seems to be a fair judgment[11] that the first contribution to make a substantial impact is the Debreu and Scarf paper. However, after the Debreu and Scarf paper, there is again a long time lag, this time between the application of game theory and its widespread acceptance, the take-off period being the beginning of the 1980s,[12] and the virtual dominance of economics being completed around the end of that decade.

Speculating about the timing of this, Rizvi (1994) argues that the primary factor explaining the spread of popularity of game theory was that it had become apparent for most theoretical economist that the general equilibrium project had encountered severe difficulties. Among these difficulties was the much discussed result due to Mantel, Debreu and Sonnenschein result about the arbitrariness of excess demand functions in GE theory and the difficulty of handling imperfect competition in GE. In this situation, game theory simply came to the rescue of theorists and saved them from the inherent arbitrariness of GE theory.

There is arguably much truth to this story, although it also underestimates the fact that (partial equilibrium) industrial organization economics became a very fashionable field in the 1980s, and that field leaned heavily on game theory. In other words, game theory in

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[9] Specifically, Debreu and Scarf (1963) showed that under perfect competition conditions, letting the number of agents in the market tend towards infinitiy collapses the core of the market game into the set of equilibrium prices.

[10] But only because they wished to draw on Nash's use of Kakutani's fixed point theorem, and could see the strong similarity between proving the existence of competitive equilibrium and proving the existence of equilibrium in an n-person, non-cooperative game.

[11] Although I cannot back this claim up by quotation data.

[12] As late as in 1979, Littlechild notes that "... for some time there has been a state of disillusion with the whole approach. Some game theorists believe a feeling of optimism is gradually returning" (1979: 145).

economics did not just emerge because of certain logical problems in general equilibrium; it also took hold because it was inherently better equipped than general equilibrium theory to deal with a number of issues. This was anticipated in the early 1970s by Oskar Morgenstern (1972) when he observed that economists had, sooner or later, to abandon "the Walras-Pareto fixation", that is, the preoccupation with competitive equilibrium, and turn to analysis that includes much more comprehensively the formation of beliefs, rivalry and competitive struggle – issues that Morgenstern implied were much more adequately treated in the game theory that he had helped found.[13] It is appropriate at this point to turn to the Austrian critique of mainstream theorizing, for if there are any economists who have urged the profession to abandon "the Walras-Pareto fixation", it is certainly the Austrians.

III. The Austrian Critique of the Mainstream

At least since the socialist calculation debate – and possibly earlier[14] – the perhaps main target for the scholarly critiques of Austrian economists has been the general equilibrium model. Although some modern Austrians – such as Mises (1949) who constructed his own general equilibrium *pendant*, "the evenly rotating economy" – have seen some merit in the use of the construct as an analytical foil, other Austrians, such as Lachmann (1986), have rejected general equilibrium theory altogether and for all purposes. Presumably, all Austrians strongly reject the Chicago "equilibrium always" strategy in which virtually all observed economic phenomena are interpreted as realizations of an underlying dynamic

[13] Indeed, the probably first area that was completely and successfully conquered by game theory was one in which at least the rhetorics concerns the formation of beliefs, rivalry and competitive struggle. This area is industrial organization economics, where the SCP paradigm associated with Bain, Mason, and others is now virtually completely defunct.

[14] This issue is a little bit tricky, depending somewhat on one's understanding of "Austrian" and dating of the socialist calculation debate. Both Wieser, Schumpeter and the early Hayek admired general equilibrium economics, and Böhm-Bawerk essentially also constructed general intertemporal equilibrium models. The critique of general equilibrium theory in Austrian thought was anticipated in Menger's critical attitude towards Walras, but does not seem to have been carefully articulated before Hans Mayer's work (Mayer 1932). There is an argument that is was the socialist calculation debate that finally made the Austrians realize how different they were from the Walrasian orthodoxy that was slowly beginning to emerge as the dominating core theory in the mind-nineteen thirties (e.g., Kirzner 1988). For the argument that internal problems in Austrian business cycle theory were also important in this process, see Foss (1995).

general equilibrium model.[15] In fact, Austrians continue to debate the merits and (particularly) drawbacks of the general equilibrium model (Kirzner 1997; Boettke 1997).

Indeed, Austrians still tend to identify (the core of) mainstream or neoclassical economics with the general equilibrium model, and a favorite pastime of Austrian economists, as we all know, is criticizing the mainstream. To quote Israel Kirzner from his recent *Journal of Economic Literature* survey of recent Austrian work, it is at "the basis" of the Austrian approach

> ... that standard neoclassical microeconomics, for which the Walrasian general model (in its modern Arrow-Debreu incarnation) is the analytical core, fails to offer a satisfying theoretical framework for understanding what happens in market economies (1997: 61).

One may, of course, seriously question whether any GE serious theorist (apart from Fischer Black and Robert Lucas) have really thought that GE theory offers "a satisfying theoretical framework for understanding what happens in market economies" (see Hahn 1984), but that is not the critical point here.

Rather, the point is that for a number of reasons, the centrality of the general equilibrium model in the critiques of Austrians and their apparent identification of it with (the core) mainstream economics may be increasingly misguided. First, general equilibrium doesn't at all hold the same sway over the profession as it possibly did two or three decades ago.[16] Second, to some extent, it is descriptively true to say that general equilibrium theory is dead – or at least dying. Third, as we have seen already, the dominant paradigm today is game theory and not the competitive equilibrium model. Hicks and Samuelson have given way to Morgenstern and Von Neumann.

The problem is that Austrians seem to be unaware of this development, or at least, they have not explicitly reacted to it. However, the position here is that Austrians should take a stand

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[15] This is what Reder (1982) calls the "tight prior assumption".

[16] "Possibly", because the number of academic economists who worked on refining GE was actually quite small and there has continuously been a large number of mainstream economists who haven' been so charmed by the GE model, for example, older (pre-Lucas) Chicago economists such as Stigler, Friedman, Coase, and others.

on game theory.[17] It is fully acceptable for a small group of economists with a distinct outlook to carve out a niche for themselves, and Austrians may be most comfortable swimming in the waters of methodology, economic policy and comparative systems. On the other hand, it is hard to deny that perhaps the most remarkable achievement of the Austrian school in the last decades – the refinement of the Austrian view of the market process in the works of Israel Kirzner – relates directly to issues that are central to game theory. Thus, non-Austrians may ask how the Austrian view of the market process relate to, say, game theoretic IO, and they may be entitled to expect an Austrian answer. Indeed, when Kirzner (1997: 64) notes that modern presentations of the entrepreneurial discovery approach have tried to

> ... demote the concept of perfect competition from its position of dominance in modern neoclassical theory, in order to replace it by notions of dynamic competition (in which market participants are, instead of exclusively price takers, competitive price – and quality – makers),

any modern game theoretic IO economist is likely to retort that this is *exactly* what been has going on in IO in the last two decades.

A further related consideration brings us back to the point that the Austrian critique of equilibrium may be slightly out of date. When Austrians are criticizing "equilibrium economics", they are criticizing, as we have seen, the competitive GE model. Indeed, "equilibrium" in Austrian texts are almost always synonymous with optimal competitive general equilibrium, a view that is implicitly defended by pointing to the importance of the latter model (e.g., Kirzner 1997).[18] But surely there is much more to equilibrium than this model. The basic text-book monopoly model does not, for example, portray the price-taking behavior criticized by Austrians.[19] And what about ordinary Marshallian partial equilibrium; do the reservations that may be hold with respect to GE also apply here? More to the point, application of game theory to economics has now resulted in a plethora of equilibrium

[17] The point that there are many research traditions in modern economics that Austrians ought to relate to, and perhaps join forces with, is elaborated in Foss (1994).

[18] See also Machovec (1995) for a brilliant discussion and critique of the sway that the perfect competition model has had over the minds of economists in this century.

[19] Although admittedly the monopolist's choice is in reality just as constrained as the choice of an agent in competitive equilibrium. However, such is the nature of all (single-exit) modelling.

concepts, most of which are refinements of the basic Nash equilibrium concept. Are these equilibrium concepts equally problematic as competitive equilibrium? All of them? Only some of them? Why? In order to ease the process of relating to game theory, I shall in the following present two different Austrian views of game theory, one for and one against.

IV. For Game Theory: an Austrian View

Game Theory as a Part of the Austrian Tradition. A favorable Austrian view of game theory may begin by noting that game theory is simply one outgrowth of the Austrian research program founded by, in particular, Menger and Böhm-Bawerk.[20] Specifically, game theory, and its applications in economics (particularly in IO), is Austrian in its concern with plan formation and plan consistency, in its much more explicit treatment of the role of time in economic affairs, and in its insistence that the competitive equilibrium model is merely one (very unrealistic) model among many others and certainly not the one that all of economics should be founded upon.[21]

In such a reading, there is rather direct line of influence from Menger and Böhm-Bawerk's concern with less than perfectly competitive situations (e.g., Böhm's famous horse-trading example, Schotter 1974) over Hans Mayer's (1932) concern with plan-formation and -interaction to Morgenstern (1935a&b) and Hayek's (1937) concern with the epistemic preconditions of equilibrium to Lachmann's (1986) radicalization of the very same themes. And Von Neumann and Morgenstern (1944) is simply one, formal, instantiation of this Austrian tradition, although any Austrian would regard as merely a very first step than needed to be taken in a much more dynamic direction. Andrew Schotter (1992: 97) argues in favor of this position:

[20] In many respects, Wieser was closer to the competitive equilibrium vision of Walras and Pareto than Menger and Böhm-Bawerk.

[21] For example, a key point in both game theoretic contract theory (e.g., Salanié 1997) and in IO (Krouse 1990) concerns the timing of actions, because final outcomes are often crucially dependent upon this. Thus, in a contractual relation, the timing of payments may influence how much effort is exerted.

> In terms of economics ... [Von Neumann and Morgenstern 1944] was a natural outgrowth of several earlier ideas of Morgenstern's and must be appreciated as a milestone in the evolution of Austrian economics.[22]

Such an interpretation is admittedly somewhat extreme and needs to suppress the traditional Austrian critique of formalization, as well as the fact that rather few of Morgenstern's distinctly Austrian themes actually emerged in Von Neumann and Morgenstern (1944). But one could perhaps defend it by taking a broader view, and see the"Austrian'ness" of game theory more as a matter of stressing the subjectivism of plans (i.e., the "beliefs" that underlie "strategies" in games), the critique of competitive equilibrium, and the sequential nature of actions in the market process (which may be given to an equilibrium interpretation).

The Market Process and Entrepreneurship. Although disequilibrium behavior has caused problems for game theorists, at least some aspects of it are given to game theoretic formalization. In a splendid, but neglected paper published almost twenty years ago, Stephen Littlechild (1979) tried to accomplish exactly this, arguing that cooperative game theory could be used to model an entrepreneurial bargaining process, and undertook some formal modelling of this. Austrians have unfortunately paid no attention to this work.

Other recent insights in game theory also offer the possibility of finding a room for the entrepreneur. For example, in many coordination games, there may be multiple equilibria, some of which may be symmetric (same pay-offs for the involved agents). Although repeating coordination games is one way of making sense of conventions (Young 1997), it can also be used to make sense of the leader/entrepreneur, since he can thought of as selecting a specific equilibrium. A somewhat related example occurs in connection with iterated prisoners' games. As is known from the Folk Theorem, even very simple iterated PD games are likely to have multiple equilibria (depending on what is assumed about discount rates), and more complex games with multiple players and incomplete information – that is, real life games – certainly do have multiple equilibria.

There are many implications of the multiplicity of equilibrium phenomenon that should be of interest to Austrians. First, it supplies a powerful argument against the standard

[22] Actually, we need an article-length study of the "Austrian'ness" of Oskar Morgenstern. Schotter (1992) is a first step in that direction.

mainstream instrumentalist position that because the economy somehow will home in on "the" equilibrium, there is no need for an inquiry into the disequilibrium market process. If the resulting equilibrium is crucially dependent on the process, this argument does not hold water. Secondly, the introduction of multiplicity of equilibria means that there may be a room for the entrepreneur, broadly understood as the agent that helps pushing the system from one equilibrium to another. For example, applied to firms, the Folk Theorem tells us that there may be many different ways of motivating cooperation, for example, many different ways of structuring retaliation schemes. However, the problem of choosing one such way – that is, make players coordinate on a specific equilibrium – is fundamentally a coordination problem whose solution may require the intervention of somebody equipped with "entrepreneurial" qualities, broadly conceived (for further examples and discussion, see Foss 1998).

Later work on learning processes in games may also be argued to have taken a broadly subjectivist stance. Although much game theory begins from a situation in which players have perfect knowledge of virtually anything but a few variables, a growing literature asks much more radical questions, such as, How do players acquire knowledge of the game in which they take part? How do they acquire knowledge of other players? If several equilibria exist in the game, how do players over time coordinate on one equilibrium? Etc. This literature is a considerable advance relative to earlier, non-game theory approaches to learning that tend to look on only competitive situations, represented as sequences of temporary equilibria. This means that severe restrictions are placed on the possible behaviors of agents, because they have to respect the restrictions imposed by a competitive set-up (Kreps 1990). In contrast, game theory allows what seems to the Austrian to be the natural procedure: *first* we specify the behaviors of agents and *then* we examine the interaction of those behaviors. Thus, disequilibrium situations are given to formal treatment.

In a fascinating and representative study, Crawford and Haller (1990) discuss the issue of how agents may learn to cooperate in the context of a repeated coordination game[23] with imperfect information. The imperfection of information in their games is a matter of strategic uncertainty, stemming from the presence of symmetric equilibria and the complete

[23] This is a game in which there is no conflict of interests, as, for example, when players in a "state of nature" has to choose which side of the road to drive in.

absence of any focal points.[24] The only way in which players can communicate is through playing the game. However, eventually sort of convention (or focal point) about which strategies to play will emerge and produce optimal subgame perfect equilibria. Thus, to put it in Austrian terms, there is no end-state (the subgame perfect equilibrium) existing ontologically separate from the process of coordination, so that "order is defined in its process of emergence" (Buchanan 1982).

Institutions and Spontaneous Order. Game theory ideas have been used in a number of attempts during the last 10-15 years to address Austrian and classical liberal ideas on the spontaneous emergence of beneficial institutions (e.g., Schotter 1981; Sugden 1986, 1989; Young 1996). Indeed, game theory appears ideally suited to deal with issues that have traditionally been a major concern to (Hayekian) Austrians, such as the formation of conventions and other spontaneous orders.[25] A number of these make the connection to Menger and Hayek explicit (e.g., Schotter 1981; Sugden 1986). Similarly, a number of non-Austrian but clearly sympathetic economists (e.g., Langlois 1986; Witt 1986; Buchanan 1997; Klein 1997) have utilized game theory to analyze institutions, in some cases extensively.

To sum up, the bottomline of a positive Austrian view on game theory is that, first, historically there is a close connection between Austrian economics and game theory through the important of Oskar Morgenstern, second, that game theory appear to be able to address favorite Austrian explananda (such as spontaneously emerged rules) that standard neoclassical economics cannot handle, third, that game theory in economics means that the formal economist is no longer tied to the competitive general equilibrium model, and, finally, that game theory makes it possible to treat learning processes (and therefore also market processes) in a sophisticated way. However, needless to say there are also strong Austrian arguments against game theory. Let us take a look at these.

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[24] At the outset, the players have different descriptions of the game. For example, they may both think of themselves as, for example, the row player.

[25] The point that game theory is much better equipped to come to terms with institutions than standard neoclassical theory is made several times in Von Neumann and Morgenstern (1944) (see also Morgenstern 1972; Schotter 1992).

V. Against Game Theory: a Negative Austrian View

Formalization. *Prima facie*, it is quite easy to find a number of reasons why Austrians should dislike game theory. One such reason, which I confess to find superficial, is that game theory uses formal methods, a reason that may be further supported by the Misesian position (Mises 1949) that there are no constants in human and that therefore quantitative and formal methods are not warranted in the social sciences.[26] I confess to finding this view both superficial and, first, because it seems to me to rest on a conflation of "formal" and "quantitative", and, second, because it amounts to a wholesale rejection of all formalization in economics. While formalization may often go too far and live a life of its own, although its advocates may have grossly oversold it in many instances, and although it seldom brings much genuinely new,[27] formal modelling is often simply the only way to handle a complex world. It is exactly because it is so difficult to analytically keep track of "the everyday business of living" (to use Marshall's terms) that formal modelling may (sometimes) be useful – *not*, as Boettke (1996) thinks, the reason why it is of little or no value. (More about this later).

Misrepresenting Human Action. A more substantial objection is that game theory appears to either equip agents with hyper-rationality (standard game theory) or portray them as completely stupid programmed puppets (evolutionary game theory) – both arguably denials of the praxeological character of human action (Mises 1949). Thus, in many (standard) game theory analyses, agents are supposed to know things (e.g., all other players' preference orderings) that they wouldn't even know in the canonical GE model. In these respects, game theory is sometimes epistemically more extreme than GE theory. In evolutionary game theory, on the other hand, one goes to the other extreme and portrays agents as following rigid rules, even if these turn out to be completely irrational.[28] The critical point here is that both approaches – the standard and the evolutionary game theory approaches –

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[26] It is noteworthy, however, that a recent collection of papers on "market process economics" contains a number of formal papers (Boettke and Prychitko 1998).

[27] The economic substance is usually provided in what usually formalists, and somewhat pejoratively, characterize as "intuition" (a remarkably imprecise use of that word!), and which has historically normally been put forward by non-formal economists.

[28] A number of attempts to add more behavioral realism in the form of bounded rationality have been made (see Kreps 1990).

essentially imply that the entrepreneurial process of discovery becomes suppressed: in the standard approach there is no need for, because, roughly, agents already know all that is worth discovering, and in the evolutionary approach, they are too stupid anything anyway.

Equilibrium Methodology. Closely related to this, the coordination problem that Hayek (1937) forcefully highlighted in the economics of his day is still very much present in most of game theory; most game theorists simply *assume* that agents can coordinate on a desired equilibrium without giving substantive reasons for this. Game theory rests on equilibrium notions, and game theorists, like earlier neoclassical theorists, have spent comparatively little time examining the process of adjustment to an equilibrium.

As has already been suggested, much recent work in game theory has consisted in refining various equilibrium concepts (Fudenberg and Tirole 1995). In contrast, the basic issue of how players actually home in on a coordinated state – how the Hayekian knowledge problem is actually solved – has been offered less attention. Indeed, the suspicion may be entertained that game theory has become so popular because it seems to solve the coordination problem (or, stability of equilibrium problem) that characterized general equilibrium theory. It does so, however, by appeal to pure ratiocination: agents simply reason their way to equilibrium, as it were – a procedure expounded already by Von Neumann and Morgenstern (1944: 146-148).

Some justification for focusing on only Nash equilibria (or, per implication, derived equilibrium concepts) was provided by Aumann (1974). He argued that if pre-play communication was allowed, but players couldn't commit to certain actions, they would only consider self-enforcing outcomes, that is, Nash equilibria, the basic reason being that no external enforcement was available. However, the basic justification for focusing on outcomes that are Nash still mostly proceeds in terms of pure ratiocination; there is an underlying assumption that players can coordinate their strategy choices on any desired equilibrium.[29] But if that is the case, the hand running the market is very visible indeed; standard game theory analysis has difficulties make sense of the notion of unintended

[29] The exception is, of course, constituted by evolutionary game theory, which, in some interpretations, provide a justification for focusing on Nash equilibria (Weibull 1995). See Aumann and Brandenburger (1995) for a recent discussion of the "epistemic conditions for Nash equilibrium".

consequences, simply because it makes so strong assumptions about the epistemic powers of individuals.[30]

It is worth confronting this with Morgenstern (1935a&b) and Hayek's analysis of the connection between knowledge and equilibrium. Essentially, and in terms of game theory, they questioned the legitimacy of beginning from what is essentially an existence that if rational players have commonly known and identical beliefs about all other players' strategies, then those beliefs are consistent with some equilibrium in the game. The problem is that nothing is said about the origin and formation of beliefs, so that it is in principle that although there exists an equilibrium in players' strategies, they may never be able to realize that equilibrium. Clearly, simply proceeding by eliminating various equilibria by means of various refinement procedures will not do; we still need to rationalize the emergence of beliefs that can sustain the final equilibrium – and here existing game theoretical work is sparse compared to the enormous amount of work that is exclusively concerned with game theoretic equilibria.

VI. Austrians and Formal Modelling

The way in which Austrians are likely to react to game theory is dependent upon how they conceive of Austrian economics. Thus, a Lachmannian or Shacklian radical subjectivist is likely to react with hostility to game theory. In his view, game theory does the bad thing that all formal theorizing does, namely it illegitimately portrays creative and imaginative human beings as pre-programmed stimuli-response puppets. An Austrian who, inspired by Kirzner's work, thinks that what fundamentally sets Austrian economics apart from other approaches is the emphasis on the market process as an entrepreneurial process of discovery of hitherto undiscovered new knowledge may criticize existing game theory for its neglect of this aspect, although he should recognize that game theory is formally capable of dealing with the entrepreneurial discovery process (Littlechild 1979). The die-hard Misesian may criticize game theory for its supposed introduction of "constants" in human action. Those with a more Mengerian "essentialist" attitude may think that formalization directs attention

[30] Notice that I am not here talking about game theory in general, but about "standard game theory", which is more less models with complete information and common knowledge. In contrast, game theory work by, for example, Sugden (1986) certainly successfully makes sense of the notion of unintended consequences, as observed earlier.

away from the important task of conceptual analysis and general inquiry into the true nature of social phenomena.[31] Austrians with a more Hayekian leaning may, on the other hand, like game theory for its attempt to deal with favorite Hayekian themes, such as spontaneous order, the emergence of conventions, etc.

All Austrians are likely to criticize the strong equilibrium orientation in game theory, as well as the sometimes bizarre epistemic assumptions that are routinely made. However, Austrians with what I think of as a more balanced outlook may recognize that, viewed against the background of the earlier dominance of the competitive general equilibrium model, game theory does indeed represent an advance in the mainstream that Austrians may find it easier to relate to than much previous mainstream work.

Ultimately, I think that the crux of the matter concerns Austrians' relations to formal modeling. Formal modeling always involves mind constructs (Machlup 1978) that are only intended to capture some aspects of reality. Moreover, there are things that a formal mind construct cannot do; for example, we cannot let the mind construct introduce actions that are completely new to us, the modellers. It is contradictory to model such "objective novelties" (to use Witt's 1989 terms). That is the limitation of all modeling. However, it is possible to model more limited versions of "novelty", for example, to let one agent (an entrepreneur) introduce actions that are novel to the other agents being modeled (as in Littlechild 1979; Fisher 1983).

Austrians are likely to object that typically formal modeling equips mind constructs with wildly unrealistic epistemic powers. O'Driscoll and Rizzo (1985: 21) present an argument against this procedure:

> The creator of the mind construct cannot attribute any type of knowledge to it that will ultimately rationalize the phenomenon in question. The construct ought to possess only that knowledge which, in terms of its position or what it deems relevant would have been reasonable to acquire. It is not appropriate to attribute to a farmer construct, for example, knowledge of demand and supply conditions in the steel industry or of the general equilibrium of the commodities he grows.

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[31] This particular objection is not likely to have much success against game theory. Game theorists are very much bent on essentialism and conceptual analysis.

While this is indeed a strong and justified critique of at least strong versions of rational expectations modeling methods and perhaps also of common knowledge assumptions in game theory, it is not a critique of formal modeling *per se*: One can certainly construct formal mind constructs that do conform to the requirement of "understandability" that O'Driscoll and Rizzo (1985: 21) imposes on mind constructs.[32] The usual mainstream argument against working with what an Austrian may think of as an "understandable" mind construct – that is, one whose epistemic powers may be much more limited than the standard rational economic man but who, on the other hand, is also possessed of entrepreneurial alertness – is that anything but perfection is arbitrary. In other words, while the perfect rationality (Robbinsian maximizing) model gives unequivocal answers (single-exit solutions), anything can happen once we leave this ideal and introduce considerations of bounded rationality, alertness, etc.

Well, one obvious answer is: So what? If the real world really is fundamentally messy, we are likely to be fundamentally misled by models that abstract from this, and we are, at any rate, certainly capable of modelling messy behaviors and their aggregate implications, even if the modelling is much less tractable than much of what goes today in mainstream economics. Indeed, in principle many of the ideas that Austrians have focused upon – subjectivism (e.g., differing expectations and knowledge), the market as a social learning process (Hayek 1968), and entrepreneurial alertness (Kirzner 1973) – are in fact given to formal modelling, although formal accounts may never capture the richness of verbal discourse. Therefore, it is to misunderstand the nature of formal modelling to believe that it commits one to, for example, the behavioral assumptions of mainstream economics, although, undeniably, these assumptions have historically taken hold in their specific forms precisely because they easily lend themselves to formalization.

VII. Conclusion

This paper has been an attempt to identify the pros and cons of game theory from an Austrian perspective and thus perform a stocktaking that hopefully may be useful to

[32] They are not completely clear here, but seem to mean that what the mind construct can do shall be realistic in a broad sense: "An 'understandable' relation must be understandable in the structural terms of commonse interpretation of everyday life. Hence the scientific constructs must be *consistent* with, although not identical to, the mental constructs of everyday life" (ibid.).

Austrians. While there are many strong arguments against game theory, it is also the case that game theory may be the best existing analytical vehicle to choose to the extent that Austrians try to dress their arguments in more formal garb. It allows the analyst to at least potentially come analytically to grips with key Austrian ideas on subjectivism, coordination, rules and institutions, and the entrepreneurial market process. In particular, the emerging literature on repeated coordination may be of appeal to Austrians because this literature asks the fundamental questions, such as how diverse players, with different knowledge and expectations, may eventually home in on a coordinated state.

Moreover, it is a literature that stresses the role of beliefs rather than the role of (misaligned) incentives in coordination problems. This should also be appealing to Austrians. At least since the calculation debate, Austrians have emphasized that the economic problem of society is not merely one providing the right incentives, but more fundamentally one of coordinating knowledge and expectations. The emerging game theory literature on iterated coordination games is perhaps the first serious mainstream attempt to address some of these coordination problems, and it is a literature that is just to interesting for Austrians to be ignorant of.

The main conclusion, therefore, is that while Austrians should cautiously approach game theory in economics, this is at least potentially one way in which Austrians can relate to those part of the mainstream that are most congenial, where they may have something to offer because of their long standing concern with non-standard coordination problems and also where they may draw inspiration to dress their own ideas in more formal garb. Lest anyone believes that game theory is a sterile mathematical area, it should finally be added that it is an area increasingly characterized by methodological and philosophical discussion of core issues of central interest to Austrians, such as methodological individualism (Vromen 1997), how to justify beliefs (Bichieri 1993; Colman 1997; Colman and Bacharach 1998), etc.

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